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XIII.—*Considerations on the great Isthmus of Central America.*

By Capt. ROBERT FITZ-ROY, R.N. Communicated by Dr. SHAW, Sec.

(Read Nov. 11 and 25, 1850.)

AMONG the important public questions of the present day is one which has attracted particular attention during the last half-century—not only as a geographical investigation, and as a philosophical problem to be solved, but as a subject eminently commercial, philanthropic, and political. The union of the Atlantic and Pacific Oceans by a navigable channel through the great American Isthmus* is the principal question contemplated.

Subordinate to this grand idea—a conception that the present age may see realised—are various schemes for roads and canals, which, since the sixteenth century, have interested the western world.†

Since Nuñez de Balboa first saw the South Sea (1513), and on his knees thanked Heaven—since Drake, from a lofty tree, beheld both oceans (1572), and, with other ardent explorers of those regions, satisfied himself that only a narrow isthmus separated the great waters—innumerable plans have been considered, with a view to effect an inter-oceanic communication.

Crowds have followed where those leaders showed the way; and a variety of information has been accumulated, which, however deficient in some respects, is now easily accessible, and needs only to be compiled, and impartially collated, in order that it may become readily available. The intention of this Paper is to give a concise summary of the most trustworthy information extant, relative to passages across the Isthmus.

Besides the illustrious Humboldt, whose works are text-books for the world, many authorities have been consulted, and the most recent information has been studied, as well as that of early date. A list of these references will be given at the conclusion.‡

The principal object in view is a navigable channel between the two oceans, through which the largest ships may pass, without breaking bulk or being lightened; the least object contemplated is a common waggon-road: and between these limits other

* By the expression “great American Isthmus” is understood all the comparatively narrow extent of land that unites the two continents, and with respect to them is, strictly speaking, an isthmus. Each narrower part of this great tract is usually referred to by a specific appellation, as the Isthmus of Darien, the Isthmus of Tehuantepec, the Isthmus of Panama, &c.

† Many proposals for canals were submitted at various times to the Spanish government.

‡ Quotations will be generally avoided, except as notes; not only to save the reader's time, but because this paper is professedly an abstract of the operations and opinions of others, and not the result of individual labour or experience.



Y OF HONDURAS

Truxillo

Comayagua

Tegucigalpa

Choluteca

Leon

Managua

Granada

Nicaragua

Port S. Juan del Sur

Port Culebra

C. Blanco

Gulf of Nicoya

Pt. Pailon

Gulf Dulce

Pt. Puriscal

Yoro

Foyas

Juticalpa

Matagalpa

R. Escamido or Riverfields

Managua

Granada

Nicaragua

Port S. Juan del Sur

Port Culebra

C. Blanco

Gulf of Nicoya

Pt. Pailon

Gulf Dulce

Pt. Puriscal

Pt. Puriscal

Caratasca Lagoon

C. Gracias a Dios

R. Correo

R. Tocas

Pearl Cay Lagoon

Blewfields

Monkey Pt.

S. Juan de Nicaragua (Grey Town)

Colorado R.

R. Macho

Pt. Pailon

Gulf Dulce

Pt. Puriscal

Pt. Puriscal

Pt. Puriscal

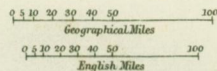
Pt. Puriscal

MAP OF THE ISTHMUS OF CENTRAL AMERICA

To illustrate

The Paper by Capt. Robert Fitz Roy R.N.

1851.



A T L A N T I C

O C E A N

BAY OF PANAMA

methods of transit will be noticed ; which may be classed under four heads—namely, Ship-canals : Boat-canals : Railroads : and Waggon-roads.

Having thus indicated the subjects for consideration, our inquiry may be facilitated by prefacing it with a few brief remarks on the present methods of conveyance across Central America ; also on health in that climate ; on storms ; on volcanic effects ; on the aboriginal Indians ; and on political obstacles.

Men, horses, and mules have hitherto carried all that has been transported from sea to sea, where barges* or canoes have not floated. It may indeed appear strange to persons unacquainted with the climate and character of those regions, that in the middle of the nineteenth century, after ages of traffic across a neck of land only thirty miles wide in some places (which is not twice the length of the Isle of Wight), there should have been no road—literally no kind of continued roadway across any part of this singular barrier—until Californian gold caused old mule-tracks to be frequented, and new roads commenced. Much traffic through continued woodland, the rapid growth of vegetation, a soft tenacious soil, and an extraordinary amount of rain, have hitherto destroyed and almost effaced such attempts at road-making as were effected in former days, even by the exertions of the early Spaniards, who employed slaves, and also availed themselves of Indian labour, unscrupulously. Canoes still struggle along very irregular rivers, sometimes pushing among trees, sometimes stuck fast on shoals, sometimes endangered in rocky rapids, according to the nature and depth of the streams, which vary greatly in opposite seasons. The slow and toilsome nature of such ways can be appreciated fully by those only who have travelled in tropical forests during the rainy season.

In these regions roads must be made with large logs of wood (corduroy) or paved with stone, or else macadamised with an unusually thick layer of ‘metal,’ until an embankment (or ‘battery’) fit for a railway can be constructed.

Having referred to the climate, that subject may be noticed here cursorily, and reverted to subsequently, being a very material consideration.

Excessive wetness (rather than humidity), owing to torrents of rain, and continual showers between the periods of incessant downfall, may be considered the principal impediment to constructing roads, bridges, and the solid works of canals. Not only do these floods act immediately on the earthworks, but they cause such a quick growth of vegetation (under a tropical sun), and so rapid a decay of all ligneous substances, that man—enervated as

* Bougos.

he is by a permanently high temperature accompanied by much moisture—is scarcely able to clear the ground and construct his work before it is overgrown and beginning to decay.

Miasmatic exhalations (or malaria) are engendered in low situations, especially near the confluence of fresh and salt water, or near river mud, or decaying matter, by which illnesses are occasioned, particularly to Europeans and their descendants, before they become ‘acclimatised.’ Intermittent fevers, ague, and at times the pestiferous yellow fever, are common in such situations; but care and good medical advice cure the majority of cases; and it is remarked that those persons who have been thus ‘seasoned,’ as it were, do not usually suffer again from the same malady.

Another serious impediment to the permanence of solid works is, the liability of the greater part of these countries to the destructive effects of volcanic convulsions. It ought to be remembered, however, that the vicinity of Panama has not been known to suffer from such disturbance. That district appears to be one of those limited tracts, sometimes found in volcanic regions, on each side of which earthquakes and eruptions occur without affecting the central district.* It does not appear, moreover, that there have been eruptions or violent earthquakes during the last few centuries in any part of the narrow isthmus usually called Darien.

By storms, or by common gales of wind, the southern part of Central America is less troubled than the northern. It is not so subject to violent tempests as the coast of Mexico, and even Guatimala; but they are experienced occasionally.†

A few diminished tribes of aborigines still inhabit the mountainous ranges of some districts. The Indians of Darien visit

* Reasoning upon the cause why certain intermediate points, at the surface of the earth, and in the direction traversed by earthquakes, are unaffected by their influence, M. de Humboldt (as if to bear out the assertion of the people of Panama that their province is not troubled by them) observes: “This phenomenon is frequently remarked at Peru and Mexico, in earthquakes which have followed during ages a determinate direction. The inhabitants of the Andes say with simplicity, speaking of an intermediary ground which is not affected by the general motion, that it forms a bridge (*que hace puente*), as if they meant to indicate by this expression that the undulations are propagated, at an immense depth, under an inert rock.”—*Liot's Panama*, &c., 1849. Note in page 39, quoting from Humboldt.

† H.M.S. *Comus* experienced a gale, amounting to a hurricane, on the 17th of October, 1833. The barometer, in this instance, gave a timely and sufficient indication by falling very low. The ship therefore quitted her anchorage at Chagres. The wind blew for twelve hours exceedingly hard, from N.W. to S.W. *All the vessels at Panama were wrecked*, and houses were blown down both at Chagres and Nicaragua.

Fresh northers, of a week's duration, sometimes almost amounting to a gale, are felt, particularly during winter and spring, at Chagres, but are much more prevalent at San Juan de Nicaragua.—*Columbian Navigator*, Purdy's, 1839: p. 217, 2nd edition.

the adjacent islets and reefs. They are the descendants of those high spirited and free 'Symérons' who were never conquered by the Spaniards, but willingly joined our countrymen in many enterprises. This tribe still opposes the exploration of certain tracts; and armed as of old with lances, bows, and poisoned arrows, or with the curious blowpipe (like that of Borneo), with its needle-like missiles dipped in venom,* these still indomitable savages are jealously vigilant in guarding their own passes. Perhaps they fear the discovery of mines studiously concealed by their ancestors from the covetous oppressors of their race; and it is likely that they may dread the exploration of some easy way of communicating from sea to sea, which, leading through their own land, would inevitably cause their eventual dispossession.†

* Captain Cochrane says that these little darts are dipped in the venom that exudes from the pores of a toad (*rana de veneno*) transfixed by a wooden skewer. "The pipe was made of two pieces of reed, each forming a half circle; these being placed together left a small hole, just large enough for the admission of the arrow. The reeds, which are about twelve feet long, were bound round with green hide, cut into thongs, and, when dry, covered with a coat of milk from the *caucho* tree (*caoutchouc*?), which, dried, prevents any air from entering, and appears of a dark brown colour. The arrows are about eight inches long, formed of a fine grained wood; the point very sharp, and cut like a corkscrew for an inch up, showing a very fine thread, that composes the spiral screw. This is rolled in the poison, which is permitted to dry on it. Round the thicker end is wound fine cotton, in the natural state, until it will just easily enter the tube, which is applied to the mouth, and aim being taken with the eye, the arrow is blown out. A practised marksman will send it with great correctness, killing a bird on the top of a high tree. The arrow will fly one hundred yards, and is certain death to man or animal wounded by it; no cure as yet having been discovered. A tiger, when hit, runs ten or a dozen yards, staggers, becomes sick, and dies in four or five minutes. A bird is killed as with a bullet, and the arrow and wounded part of the flesh being cut out, the remainder is eaten without danger. The poison is obtained from a small harmless frog, called *rana de veneno*, about three inches long, yellow on the back, with very large black eyes. It is only to be found (as my host informed me) in this place (Choco?) and another, called *Pelmar*. Those who use this poison catch the frogs in the woods, and confine them in a hollow cane, where they regularly feed them until they want the poison, when they take one of the unfortunate reptiles and pass a pointed piece of wood down his throat and out at one of his legs. This torture makes the poor toad perspire very much, especially on the back, which becomes covered with white froth: this is the most powerful poison that he yields, and in this they dip or roll the points of their arrows, which will preserve their destructive power for a year. Afterwards, below this white substance, appears a yellow oil, which is carefully scraped off, and retains its deadly influence for four or six months, according to the goodness (as they say) of the frog. By this means, from one frog, sufficient poison is obtained for about fifty arrows."—(Cochrane's *Journal in Colombia*, vol. ii, pp. 405-7.) But Dr. Cullen mentions that it is the Wourali or Curare poison which the Indians of Darien use; that it is called by them "*Corova*," and that it is made by mixing the juices of two trees which grow in the province of Choco. Waterton does not describe animal poison as being used by the Indians of tropical America. His account of the Wourali is well known.—Waterton's *Wanderings*.

In Borneo the poison used does not long retain its strength. Probably many varieties of poison are used for these little darts, as well as for ordinary arrows. Our countrymen were frequently wounded by missiles of these kinds in Borneo, without fatal consequences ensuing. See Mundy and Keppel.

† This fact is not less interesting on account of the resemblance between these Indians and the Araucanians, besides others similarly circumstanced.

Several other tribes of natives exist in the northern provinces, besides those long-trying friends of the British, the Mosquito Indians. As usual with aborigines, they shun settled districts, and dislike the laborious occupations of civilised man.

There is yet another hindrance in the way of those enterprising spirits who would undertake great works on the isthmus, which is really of consequence, namely, the political instability of the local governments. With well established and settled authorities it would be comparatively easy to make secure arrangements, but in such unsettled states as those of Central America, the political part of the question is certainly not the least difficult; and where it is proposed to carry a way through more than one state, obstacles of a moral kind oppose themselves still more forcibly. The best-concerted plans, the most elaborate precautions, the most just and liberal treaties, may be suddenly cancelled, and scattered to the winds, by revolutionary commotions.

It is necessary to remark, farther, that irrespective of climate or political considerations, there is one chief requisite, one main point, to be insisted on, in connection with any route or line intended to be available for general utility, without which advantage permanent success will be impossible. This indispensable adjunct is a good port. Without such a place of resort, at each end of any canal or railroad, easy of access and sheltered at all times, shipping could not effect their objects securely, and in definite times. Delay, expense, and risk must be the consequences of using a route unprovided with adequate harbourage.

To explain and illustrate the urgency of this consideration, let us imagine a ship-canal completed. It would not be practicable to sail into such a canal direct from the open sea. Safe anchorage must first be obtained very near the entrance; and that opening must itself be perfectly protected, not only from injury by land-floods, but from the effects of storms; from the surf and the heavy swell of the sea; and from any accumulation of mud, sand, or shingle.

Another momentous consideration must not be forgotten, which is, that the larger and better the canal, or other means of intercourse (*ceteris paribus*), the more will the world at large profit; while, on the other hand, the smaller the scale of the work effected, the more exclusively local must it become in value. An injudiciously chosen place, or a work of too limited a character, would mar the grand object, that of facilitating the intercourse of the world.

Such a communication as we are contemplating would attract crowds of shipping. It would be a thoroughfare for all nations. Let us think for a moment of the forest of masts that meets the eye in a large mercantile port, and remember that a greater multitude

of vessels may be expected, and ought to be provided for, in the event of a readily available passage by water, or even by land, being opened across the American isthmus.

Several lines have been proposed for a canal or a railroad, and each has its earnest advocates; but as interested motives may influence, and prejudice may bias opinions, it is absolutely necessary for persons who wish to be impartial to examine and compare the merits of these lines independently, without trusting to the opinion of any individual, who may be more or less biassed in favour of one particular route.

Four principal lines have been hitherto recommended, to which may be now added for consideration at least three more that offer advantages not to be undervalued, and some others of which a brief passing notice will suffice.

Taking the four principal lines in order, from north to south, the first is that between the Gulf of Mexico and Tehuantepec, which may be called, for brevity, the *Mexican line*.

The second is through the great Lake of Nicaragua, and is well known as the *Nicaragua line*. This popular route is usually taken from the Atlantic, along the river San Juan to the lake; but from thence to the Pacific no less than six different and totally distinct courses have been recommended. In this paper these separate propositions will be considered as branches of the *Nicaragua line*.

The third route crosses the isthmus near Panama, and is of course termed the *Panama line*. The fourth, from the Gulf of Darien, by the Atrato river to Cupica bay, is known as the *Atrato and Cupica line*.

Of the three lines next in importance, one is from the Chiriqui lake to Dulce gulf. Another from the gulf of San Blas or Mandinga to Chepo, in the bay of Panama; and a third from Caledonia bay, in the gulf of Darien, to the gulf of San Miguel. These almost unknown routes, the *Chiriqui*, the *San Blas*, and the *Darien*, may be considered after the four principal lines have been examined; and the other routes suggested may be noticed in passing.

The *Mexican line*, over the isthmus of Huasacoalcos (or Coatzacoalcos) leads from the mouth of the river so called, in the 18th parallel of latitude, to the gulf of Tehuantepec, near the 16th. It is about 120 miles* across, in a straight line from sea to sea, and is nowhere very much elevated: about 700 feet above the sea is, however, the lowest summit level.† The rivers

* Geographical miles, sixty to a degree of latitude, are used in this paper throughout.

† Detailed information may be obtained in this case, as in the following, by reference to one or two of the works specified at the conclusion of this paper.

that appear to afford some facilities are not really of much importance, as their waters are not deep enough to be navigable far. Their sources are separated by a tract of rocky country, and their entrances are barred by sandbanks. The adjacent coasts are frequently troubled by furious storms,* and there is no port. Nevertheless so much has been thought of this locality, that elaborate surveys have been made on two occasions; one near the end of the last century, and the other in 1842-3.† Moreover, at the present time there are persons interested in this district sufficiently to have obtained a call or an extra session of the legislature of New Orleans, in order to carry out their plans, which in that State are exceedingly popular.‡

One argument much used in favour of this proposition is, the comparatively level nature of the country intervening between the oceans; but the elevation above the sea would require a great number of locks for any canal, and a sufficient supply of water would be uncertain. A railroad may soon become locally valuable; but for the present a good waggon-road, from river to river, appears to be all that the insuperable disadvantages of position will admit, since hard gales often blow towards the land, and there is actually no port near either river in which shelter can be obtained for any but coasting craft, or other small vessels.

Other arguments are more favourable to this route, which are derived from its climate being less unhealthy than that of other lines to the southward; from its supplies of stone § and timber; from a native population inclined to work moderately, besides many peopled districts within reach, whence labour could be obtained; and from the vicinity of the United States, on one hand, while California is near, on the other. To these may be added the fact that this proposed line is entirely within one territory, therefore political obstacles might be less tardily overcome. But the work could never interest the world at large, as one more remark will probably suffice to show. The gulf of Mexico is not in the line of general intercourse between the two great oceans.

* Called "Nortes," "Tapayaguas," or "Papagayos," according to their direction—N.—S.W.—or N.E.

† In the fourteenth volume of the Journal of the Royal Geographical Society (Part ii., pp. 306-15), are the chief details of Don José de Garay's survey, executed by Moro and other qualified persons. At page 310, the locality called Tarifa is described as the proper place for dividing the waters (the lowest watershed, or summit level), so that they should flow both ways—part towards the Pacific, and the rest towards the Atlantic. The altitude of this position is given, by trigonometrical measurement, as 208·5 metres above the sea; which is 702·4 feet English. The shallowest water found then on the bar of the river Huasacalcos was said to be 6·2 metres, or nearly 21 feet English: but this is a controverted point; other authorities state that only 14 feet can be relied on in dry seasons.—*Liot*, pp. 7, 8.

‡ £100,000 value has been subscribed *very lately* for the purpose.

§ The Cerro del Convento is "a rock of pure marble."—*R. G. S. Journal*, vol. xiv. part 2, p. 310.

On account of prevailing winds and currents, ships sailing from Europe or North America must pass through the Caribbean Sea before reaching the Gulf of Mexico; and, therefore, to turn northward again to cross it, when bound to any place except California, would be going considerably out of the way, besides incurring exposure to unnecessary risk and difficulty.

On this part of the isthmus it appears then, that roads may soon become of much local value, and facilitate a passenger-traffic between New Orleans and California; but that the want of ports, and the inferiority of geographical situation, must inevitably bar its importance to *general* commerce.

The *Nicaragua line* has long attracted much attention, and public opinion in the United States, as well as in Europe, is at present rather in favour of this route. In point of geographical situation, no objection exists with reference to the general line of commercial intercourse; but exposed to gales of wind, without adequate protection from their effects, most of the proposed terminations of this route are unfit for the use of large vessels, except during very fine weather. Six branch lines, from the great lake of Nicaragua to the Pacific, have been advocated: one to the gulf of Conchagua (or Fonseca); a second to Realejo; a third to a branch of the river Tamarinda (these three being through lake Managua); the fourth to San Juan del Sur; the fifth from the Sapoa river to Salinas Bay; and a sixth from the southern part of Nicaragua, or from the river San Juan, to Nicoya gulf.

The first branch, to Conchagua, has neither been surveyed nor fully explored; the second, to Realejo, has been partially surveyed; the third, to the Tamarinda, not at all; the fourth, to San Juan, has been carefully surveyed; the fifth, by Sapoa, has been partly examined and measured. The first glance shows that the length of these lines and the number of locks must be great; and the immediate conclusion is, that delay and expense must be proportionally augmented. But these evils may be more remediable than the want of ports.

Unfortunately there is a great deal of bad weather on these coasts; and, with a view to canals or railroads, it is necessary to contemplate the character of the seasons, not at certain limited periods only, but throughout the whole year. Besides storms from the north-west during the rainy season, gales from the north-east are experienced during the dry period; therefore, harbourage is always indispensable. Excepting at two places on the Pacific, hardly available on account of their remoteness or position, there are no ports suitable for *large* ships near the terminations of this line. San Juan, now called Greytown, the only anchorage on the east coast, affords shelter to a few vessels of the smaller classes, but to them alone.

On the outer west coast there is no available harbour, excepting

Salinas bay, until Realejo is reached (which is about 70 miles distant from lake Nicaragua), or Conchagua gulf, which is nearly 100 miles from any part of the great lake. The cove on the outer coast, called San Juan del Sur, is too small and too much exposed to the ocean to be of constant service. It is but five cables' lengths across, which is only just room enough for a large steamer to turn with facility (without reference to other vessels, or the beach). It is exposed to the ocean swell, and to winds which are there very violent.

Nicaragua lake is so large (being nearly 90 miles long, and about 30 in width), that artificial harbours at the mouths of any canals opening into it will be necessary. In the comparatively still water of the lake they might be constructed, however impracticable in the open sea, where no shelter exists for such operations. The water in Nicaragua seems to vary in depth, irregularly, from 2 fathoms to 40 and upwards. It has not yet been sounded, except in a few places; but recent surveys show shallows near the rivers San Juan and Panaloya, which it may be very difficult to avoid, or even partially deepen. It has been stated that there is an ebb and flow of tide in Nicaragua, which seems unlikely, as it is elevated much too high above the sea (about 125 feet) to communicate with it underground, and is not large enough to have an independent tide. Variation in the level of the lake would be in favour of hydraulical operations, especially the removal of obstructions, and the construction of works under water.*

In the river San Juan there are rapids, and in the river Panaloya (or Tipitapa), which leads from Leon (or Managua) lake, there is a sudden fall of 13 feet, caused by a dyke of recent lava. In both rivers there are places almost dry across during the summer; and in both the winter rains cause great floods, overflowing their banks and inundating the low lands. It is evident, therefore, that these rivers could only serve as the principal feeders of canals, and that they cannot themselves be made navigable for large vessels.

It is said that the surface of Nicaragua is about 125 feet above the mean level of the ocean, and that the surface of Managua lake

* In Purdy's *Columbian Navigator*, it is stated that "the lake (Nicaragua) abounds with fish, which are so much the better from its having a flux and reflux, like the sea."—*Columbian Navigator*. Purdy: 1824. Vol. ii. p. 141, and vol. iii. p. 241. 1839.

Probably the watermarks at the border of the lake, caused by difference of level at opposite seasons of the year, have given rise to a belief in the existence of a "flux and reflux of tide."—R. F.

M'Queen likewise mentions this report of a tide in Nicaragua lake in his work on *Communication by Steam*.—p. 98: 1838.

This ebb and flow may perhaps be explained by the phenomenon "Seiches" observed in other large lakes, such as that of Geneva, &c., for which see *Journal of the Royal Geographical Society*, vol. iii. p. 271, for an article by Colone Jackson on this subject.—Ed.

is about 28 feet above that of Nicaragua.* From the Atlantic, at the mouth of the river San Juan, it is more than 80 miles to

* In Mr. Baily's work, and in the pamphlet which is said to bear the initials of the President of the French Republic, there are statements respecting the relative levels of the oceans, and of the lakes Nicaragua and Leon, that appear to be oversights. Mr. Baily ascertained the height of Nicaragua above low water in the Pacific at *San Juan del Sur*: he applied the difference between low water at Panama and low water at *Chagres* (according to Colonel Lloyd), and refers the level of the lake to the assumed low water levels of the oceans—on the supposition that the rise of tide at San Juan del Sur, as well as at San Juan del Norte, or Nicaragua (Greytown), equals those of Panama and Chagres, respectively. But this is not the case. There is a greater rise of tide at Panama than elsewhere on those coasts (except San Miguel), and a smaller at Chagres. In the pamphlet above mentioned (that by N. L. B.), there are given Mr. Baily's elevation of Lake Nicaragua, and the height of Leon (or Managua), above it, as stated by Messrs. Stephens and Rouhaud. To these are added an *assumed* difference between the level of the oceans, obtained from M. Garella, of $19\frac{1}{2}$ feet, which makes the assumed heights above the Atlantic not only that quantity greater than Mr. Baily's, but 26 feet greater; as the Pacific at low water is assumed to be $6\frac{1}{2}$ feet lower than the Atlantic at low water. Thus N. L. B. makes Nicaragua lake 148 feet (nearly) above the Atlantic, while Mr. Baily calls it 122 feet (nearly)—a remarkable difference.

Had all these observations been referred to the *mean level* of the ocean, at the respective places of observation (or as near to them as practicable), it would have been far less unsatisfactory. Moreover, in none of these measurements does any allowance seem to have been made for about 6 feet variation in the level of Lake Nicaragua in opposite seasons. The half of this, or 3 feet added to the elevation of the lake in the dry season (when Mr. Baily observed), would make 131 feet above the (estimated) low water of the Pacific. To illustrate the uncertainty of such measurements, when not referred to *mean heights*, or "datum levels" of water, it may be mentioned that at Panama the sea usually rises about *twenty-one feet*, at San Juan del Sur about *thirteen feet*, and at Chagres only *one foot*, at spring tides.

In estimating the level of Nicaragua lake, in *this paper*, the following steps are taken:—

	feet	in.
Baily's elevation above low water at S. Juan del Sur } at full moon, when the tide rose 12 feet .	128	3
	— 6	0 = $\frac{\text{rise}}{2}$
Low lake above mean sea	122	3
Half variation of lake	+ 3	3 = $\frac{\text{Variation}}{2}$
Mean elevation of lake above mean height of Pacific } Ocean	125	6
	+ 6	6 = $\frac{\text{greatest rise}}{2}$
Greatest elevation of lake above mean height of sea	132	0

In 1781 the Spanish engineer, Galisteo, made the elevation of Nicaragua lake $133\frac{1}{2}$ feet above the sea (probably the Pacific), a close agreement with modern measures as $133\frac{1}{2}$ feet Spanish = 124 feet English.

In 1736 Ulloa and Jorge Juan inferred that the mean level of the oceans could not differ much, if at all, at the isthmus of Panama, because their barometers showed equal pressures at the shores of each ocean. Humboldt made a similar conclusion. Lloyd ascertained that there is not more than three or four feet difference of level at Panama (the Pacific being the highest), and that the times of high water correspond. But M. Garella says that there are *nineteen feet and a half* between the levels of *high* water in the Pacific and *low* water in the Atlantic ocean, which seems to require corroboration—if he means what has been quoted by N. L. B. at page 11 of his pamphlet.

the lake, in nearly the mean direction of the river; and from Fonseca, or Conchagua gulf, to the north-west part of Nicaragua, the very shortest line that could be taken for a canal would measure more than 90 miles. It is more likely, however, that each of those distances would exceed 100 miles, including all bends; and, as the ground is very irregular, some idea may be formed, off-hand, of the vast number of locks that would be required, of the delay, labour, and expense of towing ships through, and of the time that would be occupied. Between Realejo (which is by no means so good a port as had been usually supposed) * and Managua lake, about 45 miles of canal would be required, and the highest level necessary would be about 212 feet above the Pacific; but at that elevation it is doubtful whether a sufficient supply of water could be *there* secured without an immense cutting, 11 miles in length, and not less than 70 feet deep (wide enough also for a canal), to convey a stream from Managua. From one ocean to the other not much less than 100 miles of canal would be indispensable, if the shortest lines were adopted; but probably nearer double that extent would be required, if the longer route, to Conchagua, were followed.

The favourite idea of cutting a canal from Nicaragua lake to the nearest part of the ocean, at San Juan del Sur, is checked by the fact that a range of land intervenes, through which it would be necessary to tunnel, and that there is not a sheltered harbour into which the canal might open, and where numerous shipping might anchor in security.

San Juan del Sur, it may be repeated, is only about 1100 yards across, open to the ocean swell, and exposed to very strong winds. The elevation of the proposed tunnel would be at least 120 feet above the lake. It must be from 1 to 2 miles in length, of dimensions hitherto unattempted, and the lowest level *over* it would be some 600 feet above the sea. How a sufficient supply of water could be obtained, is a matter of mere conjecture.

To what has been said above must be added the reflection that this district abounds in volcanoes and is subject to earthquakes.†

* See Belcher.

† Every writer on Central America describes the effects of volcanoes and earthquakes in that much disturbed region; but Mr. Baily relates (pp. 77, 78) a curious instance of the rise of a volcano to a considerable height (about 1500 feet above the sea) from a spot where men living in this country had milked cows. Some of these volcanoes eject lava and huge fragments of rock; some scatter wonderful quantities of ashes, mud and torrents of water flow over the country adjacent to others; while the relative levels of various districts are changed, sometimes suddenly, but more commonly by slow degrees. These natural convulsions are not rare occurrences, at long intervals of time, but frequent, as the annals of even late years show.

It is worth notice, as showing how prevalent the idea of volcanoes is in Nicaragua, that the *Arms* of the *State*¹ are *five volcanoes in action*—with some other minor device.—R. F.

¹ *The Seal of Government!*

In point of climate it is much the same as other parts of the great isthmus in similar situations, such as elevated or low, exposed or sheltered. Nevertheless, surveys have been minutely executed in some parts of these proposed routes, much has been said and written about them, the subject has become familiar, and conclusions have been rather generally drawn in favour of Nicaragua. These surveys, however, have not really tended to diminish the formidable appearance of so many natural obstacles. They have only given actual dimensions and position to what was before uncertain and shadowy. From surveyors themselves we cannot expect to hear much of comparative disadvantages. Earnest in their undertakings, whether independent or on behalf of employers, objections and difficulties are not accumulated. They are more likely to make too light of obstacles (with which they themselves may not have to contend), and they naturally refrain from depreciating the undertaking in which they are interested.

It is common to *under-estimate* the power of natural forces, when not immediately or visibly in operation. The swell of the ocean, the tornado, the torrent and inundation, and the wide-spreading effects of volcanic convulsions, are almost unheeded at a distance. Houses, several stories high, are to be seen newly built among the ruins caused by very recent earthquakes; and men, hoping to escape in future, close the page of history.

The next branch line from Nicaragua is from the mouth of the Sapoia river, at the S.W. part of the great lake, to Salinas bay. It is said to be about 15 miles in length, half of which is by the river, and now navigable by boats. No exact survey has yet been made, but estimated levels and distances have been noted by a competent observer (Dr. Oersted) in exploring the line. The port of Salinas is accurately known, and is a very good harbour. Between Salinas and Nicaragua the lowest summit level is supposed to be only 130 feet above the lake, and about double that elevation above the sea. There is sufficient water (it is stated) to supply a canal at that elevation. This is certainly a very interesting quarter; but more information is much wanted, especially as to levels and the supply of water.* The slight notice previously taken of this route by Spaniards or

* Dr. Oersted made his examination of this promising district in 1847, in company with Dr. F. Gutteriz (?), but was in want of the instruments necessary for accurate measurements. He states (to the minister of Costa Rica, Don Joaquin Bernardo Calvo), that the formation of a canal is there (at the Sapoia) quite possible. But he does not appear to contemplate the excavation of a *large ship-canal*. The River Sapoia, from his description, would serve only as the feeder of a canal. The highest ground that must be crossed, which he estimates at 270 feet above the sea, extends about 1200 yards only, and has higher ridges on each side, from which streams of water flow. Thence to the sea, at Salinas Bay, is about 6 miles, across low level land, with a sandy, clayey soil. The higher ground is a firm stratum, composed chiefly of porphyry, which breaks easily.

aboriginal inhabitants of the country, inclines one to anticipate some graver obstacle than has been recently stated, otherwise it must be a route more favourable than either of those to the northward which have been examined more closely. It is entirely in Costa Rica.

A *sixth* proposition is to connect Nicoya gulf with the southern part of Nicaragua, or *directly* with the river San Juan by the help of the river San Carlos. In this case an available port exists in the Pacific, but a large extent of land intervenes between the oceans, which has not been surveyed, and may be found too much elevated or in other respects impracticable.

The respective peculiarities of these six branches, as they may be called, of the Nicaragua line, cannot yet be described minutely, because insufficiently explored, excepting those of the branch by San Juan del Sur. Enough, however, is known to discourage any attempt to construct either canal or railway, unless the Sapoia track should prove to be as eligible as Dr. Oersted believes. Even then there will be the disadvantages of so inferior a harbour as that of St. Juan (Greytown), and the difficulties of the river. The disadvantages of the harbour are likely to increase, as the spit which partly shelters it is augmented yearly. The variable river, San Juan, must be cleared from its numerous obstructions, though renewed annually by floods. Untouched forests, swamps, mudbanks, and durable masses of rock, characterise both banks; and the climate of the low grounds is most pestilential. Of the materials necessary for constructing locks and other buildings, there is abundance of the finest timber, but freestone and limestone are rare. Mr. Baily says he found limestone near San Juan del Sur, but other accounts differ considerably.

The reflection cannot be avoided that, in this district, the uncertainty caused chiefly by political instability (three States being concerned, Costa Rica, Nicaragua, and the Mosquito territory) is greatly augmented by a sense of physical insecurity. Volcanoes of considerable height having risen within very recent periods; prodigious quantities of ashes, water, and lava, having been from time to time thrown over the country; and the relative elevations of land and water having been materially changed—all within the memory of living men—undoubtedly justify great hesitation in undertaking any extensive engineering operations.

Having examined the Nicaragua line and its branches with reference chiefly to a canal, it seems only necessary to remark, in this place, that no good road, on a large scale, could be profitably maintained for the *general* use of the world in that district, on account of the comparatively great distances that must be tra-

versed, the frequent alternations of land and water conveyance, and the want of adequate harbourage at the terminations.

The third principal line is by Panama.

Numerous explorations have been made in this vicinity. Canals have been proposed, and various lines have been more or less closely examined. Four routes have been critically surveyed throughout the whole distance by Lloyd and Falmarc, by Morel, Garella, and Hughes : along the last line a railroad is now in progress. This adopted route leads from Limon, or Navy bay, to Panama city, passing by Gorgona. It is to be carried about 36 miles, over elevations of nearly 300 feet, through a tunnel, and over large viaducts and bridges.

Supposing this to be the best line for a railroad between the terminations selected, let us inquire whether each terminus is at or near a good port. Chagres is well known to be unfit for large ships, but Limon bay has space and depth of water towards its *outer* part amply sufficient. Unfortunately, however, it is open to the north wind, which at times blows hard, driving in a heavy sea, and half of the bay is so shallow that when northerly gales prevail, there is a great surf in that part. A breakwater has been proposed, but a work so gigantic as would be required must exceed all that has been effected of a similar kind in modern or ancient times. A mole, or breakwater, would not fulfil its object in Limon bay unless extending more than a mile in length in at least 6 or 7 fathoms water. During its construction the heaviest seas would interfere at the time most suitable in other respects for making progress. Many comparisons of difficulties in respect of materials, labour, provisions, and climate, occur to mind readily while reverting to Cherbourg, Plymouth, Genoa, Alexandria, Algiers, or other places, where works of such a nature, but carried on under infinitely more favourable circumstances, have cost time and money far exceeding what can now be contemplated for any enterprise not of *vital* importance to any *one* country, however conducive to national prosperity and to the general interests of mankind.

Limon bay is not, at present, a safe port for shipping. It seems to be practicable, however, to excavate a large wet dock, or basin, between Manzanilla island and the main land, at the terminus of the railroad (in progress) ; and, if such a work were executed, Limon bay would become a useful roadstead accessory to an artificial harbour.

On the opposite coast, near Panama, a spacious and tolerably sheltered anchorage, with access to works *carried out into the sea*, may be found in the bay, but not very near the city. This limited separation, not exceeding two or three miles, would be but slightly detrimental to a roadway, if security, easy access,

and sufficient sheltered space could be obtained for a considerable number of vessels.

The great rise of tide at Panama, about 3 fathoms,* would much facilitate operations, and would also favour the construction of dry docks, so much wanted in the Pacific; but at present the proposed terminus is 2 miles from the nearest anchorage of ordinary shipping—2 miles across open sea—which is a serious inconvenience, and will be greatly felt in transporting merchandise, unless a viaduct can be carried out into deep water and protected from the ocean.

Although Panama bay is usually tranquil and not disturbed by much wind or sea, it is recorded that all the shipping lying there have been stranded, and other extensive damage done by an unexpected tempest.†

From Limon bay to Panama is about 33 miles in a direct line. Many rivers and ranges of hills intervene. Floods sweep the low grounds during the rainy season. The rivers are so irregular that they can be used only as feeders for a canal. They cannot be rendered navigable throughout the year for large ships.

The works necessary for a ship-canal must be on the greatest scale, not only if the lowest summit level to be passed be nearly 300 feet, which is that of the proposed railroad, but if Garella's plan, avoiding a greater elevation than 150 feet, should be adopted. It has been stated that a line may be taken between the rivers Trinidad and Caymito, in which the highest elevation does not exceed 40 feet above the sea;‡ but this account is contra-

* From two to four fathoms; sometimes more, according to Lloyd.

† Besides the remarkable instance of a severe storm in Panama Bay, already quoted in note †, p. 163, other similar occurrences are mentioned by Spanish authorities, which it would be unnecessarily tedious to recapitulate. Sufficient distinction is not always made by writers between the nature of the prevailing winds and weather of the *dry season*, and those of the *opposite* period. It is not invariably remembered that the usual descriptions of these regions, especially the Spanish, were given with reference to that time of year at which *alone* commercial intercourse could be conveniently carried on—the *dry period*—but that now we want to establish a communication throughout the whole year, at precisely regular times, irrespective (almost) of wind or weather. Panama bay is exposed during the long rainy season to westerly winds, which send in much swell. Their name, “Venda vales,” may have been derived from the fact of their bringing much rain, and therefore stopping not only the sale of merchandise exposed in the open air, but almost all commercial intercourse. “Venda” meaning sale, and “vale” farewell, seem to be the origin of the word. It may, however, have been derived from vento, or viento, wind—and vale,—this wind being most unhealthy in some places.¹

These westerly winds prevail throughout Central America during the rainy season. In Mexico they are called Tapayaguas.—(“Tapar,” to hide, and “agua,” water—*Tapar de aguas*?)

‡ Morel's plan.

¹ Causing many deaths, and therefore giving rise to the term, the *farewell wind*, or wind of parting from friends.

dicted by other authorities. If such a low summit level of the land exist, a channel might possibly be made from sea to sea, without a lock, navigable by the largest ships. In order to attain the lowest possible level, Garella proposed to excavate a tunnel, 125 feet in *interior* height, 97 feet wide, and nearly 3 miles in length. With such an enormous work and about 33 locks, he proposed to accomplish the grand object. Lloyd suggested a canal from Limon bay into the Chagres, and a communication between the Trinidad and the waters of the south by railway, if not by canal.

Not to mention the great works of the Old World—the extraordinary Mexican “*Desagüe*,” 200 feet deep and 300 feet wide for nearly a thousand yards, and above 100 feet deep through an extent of 3000 yards (making altogether 2 miles of distance in which that vast excavation would be capable of concealing the mast-heads of a first-rate man-of-war), this wonderful work, executed within the last three centuries in Central America, should induce us to listen respectfully to the plans of modern engineers, however startling they may appear at first. Humboldt says, “The ‘*Desagüe*’ is undoubtedly one of the most gigantic hydraulic operations ever executed by man.”

Whether a supply of water sufficient to feed a canal could be secured during the whole year, at an elevation of 200 or 300 feet, near Panama, seems to be doubtful, although in so rainy a climate and among ranges of heights elevated above the summit level considerably, because the summer is very dry; and the soil is extremely porous on the high lands. As no safe port is now available about this part of the isthmus, except Porto Bello, and as that harbour is so unhealthy as to have been formerly termed “the grave of the Europeans,” it may be doubted whether even a railroad will be remunerative; but assuredly there are not at present inducements sufficient to warrant the employment of private capital on a great canal. Under existing circumstances a waggon-road between Porto Bello and Panama appears to be the most feasible and least uncertain scheme, while it would tend to facilitate and encourage, rather than injure, greater undertakings, of which it would be the natural precursor.

The insalubrity of Porto Bello was diminished by clearing away woods, and might be much further improved by burning down forests,* draining marshes, and using a different site for

* Although it is difficult to burn forests in a very wet climate, it *may* be done by first cutting a quantity of (inner or solid) wood, piling it in a great heap, and setting it on fire close to a thick part of the forest. The heat caused will soon dry the nearest trees, which will then catch fire, and when once a sufficient *body of heat* is generated, a rapid conflagration will follow. Green wood burns faster and gives more heat than dry wood under the influence of fierce fire.

Even on the humid banks of the Atrato, Cochrane “saw the underwood catch

buildings. By such means the greatest evil—unhealthiness—may be so far lessened as to admit of this port being placed on an equality with other harbours on these coasts. Before proceeding further, reference may be made to the geological character of this part of the isthmus, and to the materials accessible for purposes of construction. A recent examination * informs us that the greater part of the rocks are porphyritic or hornblendic, that limited lines of granite and schistose formations occur, that silica is deficient, quartz rare, and limestone very scarce, but that iron is abundant. There are very few argillaceous deposits, and only a small portion of aluminous rock. Lime and building-stone are obtained from coral rocks on the Atlantic coast. Shells alone afford lime on the Pacific. On that side a kind of aluminous magnesia is found in thin layers, and is said to be appropriate for building. Nearly all the rocks are igneous. Stratification is not found, excepting in a few instances such as the above, chiefly near the sea, or in valleys between ridges of mountains. It will be difficult therefore to procure materials, except timber, for any great work; and the want of good clay, fit for lining (or puddling) the banks of a canal, may be a serious impediment, though by no means insuperable.

It is ascertained that there is only a trifling difference between the levels of the oceans at this isthmus. A rise of tide, not exceeding 2 feet, is found on the Atlantic side, while in Panama bay the tide rises more than 18 feet;† the mean level of the Pacific in this particular place being 2 or 3 feet above that of the Atlantic. It is high water at the same hour in each ocean.

Passing reference having been made to the importance of docks at Panama, it may be brought to mind that this is one of only three localities in the whole of the great southern ocean, where dry docks for large ships can be readily constructed.‡

The fourth principal route is the *Atrato and Cupica line*.

From the inner part of the Gulf of Darien (called Candelaria, Choco, or Culata§), up the river Atrato, and along part of the river Naipi, or Naipipi, and thence across to Cupica bay, is a distance of 114 miles (by estimation), of which about 19 only are overland. Two-thirds of this distance (76 miles) are said to be now navigable for large ships, and half the other third (or 19 miles) by loaded boats. It is supposed that a canal may be excavated through the small remaining distance (19 miles) without extraordinary difficulty; and it is proved that it might open

fire and burn rapidly, consuming a great part of the forest.”—(*Cochrane*, vol. ii., p. 452.)

* By Mr. Hopkins.

† Extreme rise known = 28 feet.

‡ The other two are Guayaquil and Chiloe.

§ Culata del golfo.

into an excellent port—that of Cupica, in which are coves *perfectly sheltered*, with *deep water* in them *close to the shore*.*

Cupica bay is spacious, but open to the south-west. In that latitude, however (6° N.), south-west winds are seldom strong; very rarely do they cause disaster; and as evidence that this bay is not affected much by them, it may be mentioned that trees grow down to the *water's edge along the beach*, and that there are no indications of a heavy surf having been known. There is shelter for any ships, in sufficient water, on each side of the bay, land-locked.

The recent survey, by Admiralty order, is quite satisfactory, as to the purely hydrographical part; but, of course, it does not show the topography of the adjacent district beyond the coast.

As this line has not been surveyed, though frequently travelled over, and as sanguine hopes are entertained that the locality may afford all the indispensable facilities for effecting a great ship-canal, it is necessary to look closely into the grounds on which such expectations are based, and try to ascertain their real character.

The officer who recently surveyed Cupica (Lieut. Wood, R.N.) states, with respect to the land between it and the Naipi, that he set out one morning from Cupica at eight o'clock, walked with native guides to the Naipi, rested there, bathed in the

* A merchant of Carthagena, Don Ignacio Pombo, wrote to the Baron de Humboldt, in 1803, "I have never ceased to take information respecting the Isthmus of Cupica. There are only from 5 to 6 leagues from that port to the embarcadero of the river Naipi, and the whole territory is a perfect level (*terreno enteramente llano*).” In Scarlett's book this quotation is followed by remarking that the communication he had held with different persons who had collected information upon that Isthmus, left him no doubt that Pombo's account was correct.

Mr. Watts, ten years Vice-consul at Carthagena, was acquainted with the owner of an estate on the Naipi, Señor Coutin, who was in the habit of crossing to the bay of Cupica, and told him that the rise between the bay and the river was gradual, and only about 150 feet in the whole. Mr. Watts stated that the Indians habitually carried their canoes from Cupica to the Naipi.—(*Scarlett*, vol. ii. pp. 251, 252.)

Humboldt, speaking from the reports of others, says, "From Cupica we cross, for 5 or 6 leagues, a soil quite level and proper for a canal—which would terminate at the embarcadero of the river Naipi. We might almost say that the ground between Cupica and the Atrato is the only part of all America in which the chain of the Andes is entirely broken. A very intelligent Biscayan pilot, Gogueneche, turned the attention of government to the Isthmus of Cupica, which *ought to be for the new continent what Suez was formerly to Asia*."—(*Humboldt, New Spain*, vol. i. pp. 39, 40. Black's 3rd Edition: 1822.)

Robinson, in 1813, learnt from Spaniards at Carthagena that, from the navigable part of the Naipi to Cupica was 24 miles, across a level tract of country.—(*Pitman*, pp. 61–4.)

In 1820, Captain Illingsworth, of the Chilian frigate *Rose*^a (or *Andes*), caused a launch, carrying fifteen men, to be drawn across this space, in ten hours, the men having to cut the 'bush' as they advanced.

^a (Watts, MS., and others.)

stream, then walked back, and reached his ship (the ' Pandora ') at noon. The guides told him that he could reach the place where loaded boats (bongos) stop, in four hours from the time of his arrival at the Naipi, by continuing to walk at the same rate (about three miles an hour, more or less, according to the ground). The place where he bathed was 5 or 6 miles from Cupica, and the point to which loaded boats ascend the Naipi (embarcadero) was then about 12 miles distant by his estimation. At first leaving the sea-beach the way was by a rapid ascent, till an elevation of about 200 or 300 feet was gained, but thence it appeared nearly level till he reached the Naipi. The most elevated ground that he walked over was not, in his judgment, 400 feet above the sea; but he thought it more than 300. He went by Indian paths, the shortest way, along the driest and clearest, therefore probably the higher ground. The natives would not consent to go, as he wished, along a river from the head of the bay, which seemed the lowest line of route, but insisted on striking direct across the higher ground.*

Independent of this account, by an officer now in England, other concurrent testimony shows that between the partly navigable portion of Naipi and the bay of Cupica there is a tract of comparatively low land through which a canal may be cut. That a road of any kind may be made there readily is shown by the fact that a boat has been dragged across in a few hours.†

With respect to ports, the survey above-mentioned vouches for that on the Pacific; and, on this side, all the gulf of Darien, and Choco, including the mouths of the Atrato, have been recently well surveyed; and there is no question as to the real excellence of the extensive harbourage in that quarter.

The character of the Atrato, and likewise that of the Naipi, are the next considerations. There are bars (sand or mud banks) at the mouths of the Atrato, which prevent the passage of vessels drawing more than five or six feet of water;‡ but within those bars (which may be partly removed, or avoided by a short canal into the gulf), or rather above the delta of the river, there is said to be water for any ship, to a place far above the junction of the Naipi. The union of that river with the Atrato appears to be about 80 miles south of Choco gulf—the southernmost part of the gulf of Darien (called also Culata, or, *incorrectly*, the bay of Candelaria); but distances thereabouts, *within the outer coast lines*,

* There can be little doubt that a march along the banks of a river in that latitude and climate would have proved to be a struggle through mangroves and mud, among alligators and snakes. Moreover, it is customary for Indian natives to select the higher grounds for their journeys, with a view to greater security from their enemies, as well as for more facility in travelling.

† The Chilian launch.

‡ Rise of tide = 2 feet.

can only be taken approximately at present. We know that the town of Citerà or Quibdo (otherwise Zitarà), on the Atrato, is at least 120 miles in a direct line from Choco gulf; and to that town vessels of about thirty tons burthen (champanes), coppered, and fit for a sea-voyage, trade regularly from Carthagena and other places. The passage of these loaded traders cannot be difficult between Quibdo and Choco gulf, as they can sail or drift down the river, not only by day, but by night.* They never tow, or 'track.' It is said to be a "noble river," wide, tranquil, and free from impediments; but it has not been accurately surveyed. The bars at the mouths are the only known hindrance to navigation, but that may be remedied, as above-mentioned, by a short cut; or by *deepening one mouth* of the river.† The inner part of Choco gulf, called "Culata del golfo" by the Spaniards, is landlocked, and has deep water, with abundant space. The course of the river is straight; its bed is said to be deep, and entirely free from 'snags,' or such obstructions.‡

The Naipi is, of course, a far inferior river, being a mere tributary; but as loaded boats pass 20 or 30 miles along it in the *dry* season, and as the upper part approaches the Pacific within 6 or 7 miles, it may be regarded as a very available feeder for a canal. It has been asserted, however, that the Naipi is "shallow, rapid, and rocky," which, indeed, at a dry period of the year, and towards the river's source, may be the case; but there is ample evidence to prove that there is always water for loaded barges ('bongos') to a certain place (el embarcadero), which is not much elevated above the sea, and not more than 20 miles from it, without any higher land intervening. On the same (disputed) authority it has been stated that there are "three sets of hills" between the Naipi and the Pacific. This may also be fact, in some particular direction; but the hills that cannot be avoided must be of very little importance, as a Chilian frigate's boat,§ that carried fifteen men, was dragged from Cupica to the Naipi in ten

* When there is moonlight.

† The inundations of this river during the rainy season must be on a great scale, and utterly prevent the establishment of permanent works on the lower banks or in the extensive marshy levels, overgrown with mangroves, bamboos, and impenetrable jungle. Only on the rising grounds can durable foundations be secured. Speaking of one part, Cochrane says, "We scarcely lost sight of huts, but the plantations cannot go into the interior above 50 yards, as the whole beyond that distance is morass."—(*Journal*, March 13; vol. ii. p. 148.) "This country, when the river is at its meridian (mean height?) is about two feet above the level of the water; but when the river rises it is entirely overflowed, leaving the tops of the trees only in sight; and this kind of country, or rather lagoon, extends in every direction."—(*Cochrane*, vol. ii. pp. 452, 453. March 17, 1824.)

‡ Mr. Consul-general O'Leary, writing from Bogotá, last April, says:—"The course of the Atrato is straight, and its bed deep, and entirely free from 'snags,' and such like obstructions."

§ A launch. Watts, MS.

hours, the men clearing a way by cutting the 'bush' as they went along; and as the Indians habitually transported their canoes over the same neck of land.*

From the opinions of those who have written on the subject, founded, as they are, solely on *estimation*, it would appear that the lowest summit level is between 150 and 350 feet above the sea; but all who have visited that district have been passing hastily across it, and have naturally sought the best path—the best *travelling ground*, not the *lowest level*. One exception may be made, in the owner of a large estate on the Naipi,† who may have examined the district more accurately (though, perhaps, with a partial eye). His opinion was, that the lowest summit level was not elevated more than 160 feet.‡

There can be little doubt that in the vicinity of watercourses, including that which leads into Cupica bay, a line may be carried *thence*—to the Atrato, if not to the Naipi—which would be suitable for a large canal. Such a project is by no means new. It was suggested to the Spanish government by a very intelligent Biscay pilot, Gogueneche by name, at an early date (when Spanish pilots were sailing masters); but so cautious were the Spaniards to prevent rather than encourage any scheme that might facilitate access to the west coast of America, or extend a knowledge of the mining localities near the Darien gulf, that it was prohibited, *on pain of death*, not only to navigate the Atrato, or pass by that river, but even to *propose* to take advantage of it, in any way, as a route.§

* Watts, MS.

† Señor Coutin.

‡ Watts, MS.

§ “En tiempo de Felipe II. se proyectò cortarlo, y comunicar los dos mares medio de un canal, y a este efecto se enviaron para reconcerlo dos ingenieros Flamencos; pero encontraron dificultades insuperables, y el consejo de Indias representò los perjuicios que de ello se seguirian a la monarquia: por cuya razon mandò aquel Monarca que nadie propusiese o tratase de ello en adelante, *pena de la vida*.”—Alcedo, *Diccionario Geografico Historico de las Indias Occidentales*, &c. Ad verb Istmo.

ENGLISH TRANSLATION.

In the time of Philip II. it was contemplated to cut a canal, and by this means to join the two seas: and to this effect two Flemish engineers were sent to reconnoitre it, but they found insuperable difficulties, and the Council of the Indies represented the evils which therefrom would accrue to the monarchy, for which reason that Sovereign ordered, *under pain of death*, that nobody should thereafter propose or entertain the subject.

“Es navegable por muchas leguas pero esta prohibida la navegacion con *pena de la vida*, sin excepcion de persona alguna; por evitar los perjuicios que se seguirian a las provincias del nuevo Reyno, por la facilidad con que se podrian internar por el.”—Alcedo: ad. verb Atrato.

ENGLISH TRANSLATION.

It is navigable for many leagues, but the navigation of it is prohibited *under pain of death*, without the exception of any person whomsoever, to obviate the evils which might accrue to the provinces of the New Kingdom, from the facility with which one would be enabled to penetrate it.

This was not done solely to isolate the western colonies. It was with a view to protect them from the incursions of piratical invaders; from the notorious buccaneers especially, and to keep secret the situation of the richest gold-mines.

The British Consul-General at Bogotá (D. F. O'Leary), writing on the 24th of last September, gives a report made to him by an engineer employed by the government of New Granada (M. Greiff, a Swede), of which the following interesting passages are *extracts*:—

“ No river in New Granada offers greater facilities for steam navigation than the Atrato; and even under sail it can be ascended during the summer months (the dry season) above the mouths of the Naipipi. Of the seven or eight mouths of the Atrato, the one called Coquito is the best for navigation,* and its bar can easily be kept free from obstructions† which in the other mouths prevent the entrance of large vessels.

“ The banks of the Atrato throughout its whole course are subject to inundations, excepting (on the left bank) the slopes of Cucericá, six or seven leagues from its mouths, which are fit for building upon. On the right bank the slopes of Tūmurado and Pulga would allow of small buildings for depôts.

“ The Indians pass from the mouth of Tarena, by the river Arquia, to the Cordillera, carrying over their canoes to the river Paya, and descend by it to the gulf of San Miguel, on the Pacific. A similar operation is performed by the Truando and other rivers, with more or less difficulty.

“ The banks of the rivers Domingado and Apagado, to the left of the Atrato, are inhabited, and generally cultivated. They produce cocoa, plantains, and maize; and there are several herds of cattle. The Naipipi, for a considerable distance, is easily navigable even for large vessels; and I think that the greatest impediment consists in the number of *snags* which are in *this smooth river*. At present, persons ascend in canoes for two days, and require half a day to go to Cupica by land, at the rate at which the natives travel, about three leagues each day. On the banks of the Naipipi there are beautiful pasture-lands, and cattle; the land is generally capital; some of it is planted with cocoa. The banks of all the tributaries of the rivers Naipipi and Apagado are fit for cultivation, and population; but those of the rivers running into the Pacific are still better, and principally those of the river Truando, where there is a settlement of runaway negroes and Indians, who are occupied in boat-building, cultivation, and in the pearl-fishery.

“ In Naipipi, Apagado, and Truando there is plenty of mahogany and other valuable wood.

“ A great part of the tract of land between the Atrato and Pacific is most advantageous for population; and the climate, although hot, is

* In 1823-4, Candelaria was the deepest, but Barbacoa the best, of nine mouths of the Atrato.—*Cochrane*, vol. ii. p. 453.

† Mud, sand, and trees.

sufficiently healthy. The Atrato itself swarms with insects and reptiles; but, as you recede from it towards the sea, the whole of the slopes, even to the coast, are good for use."

In this vicinity, if our premises are correct, and the climate can be withstood (neither of which there is good reason to doubt), we may suppose that a great canal is feasible, and that there is a substantial foundation for opinions in favour of attempting to execute such a work on a scale that would make it available for the largest ships of all nations.

For a railroad, or even a waggon-road, the neighbourhood of the Atrato cannot be suitable, because of the extensive swamps and low marshy land affording no solid foundation, and often inundated; which is said to be characteristic of both banks in some places. Roads can undoubtedly be formed more advantageously elsewhere;—by *this* line an effective communication can only be made by water.

The four principal lines have been thus summarily examined; and the result is, that only one, the Cupica and Atrato route, appears now to offer a reasonable prospect of encouragement to undertake the construction of a *ship-canal*; and that only one other route—that from Portobello, or from Manzanilla, to Panama—seems likely to become the site of a great permanent road for *general traffic*, if not for a *railway*. The other two routes seem unlikely to be adopted, except for *local objects*.

Referring now to the other lines *suggested*, but not yet sufficiently explored—Between *Chiriqui* lagoon and *Dulce* gulf a communication has recently been proposed by a French company, who have obtained a grant of land from the government of Costa Rica. Their object is said to be the establishment of a good road, in the first instance, between the lagoon of Chiriqui and the gulf called Dulce. Whatever may be the character of the intermediate district, or the extent of country to traverse, it is certain that the two points of departure are good ports—a very material advantage with which to commence operations.

Between the Panama line and that by the Atrato there are at least *three* places where surveys are very desirable; namely, from San Blas, or Mandinga bay, to near Chepo; from Caledonia bay to the gulf of San Miguel; and from that gulf to the southern part of the gulf of Darien, called Choco.

As these routes have been so little explored there is not much definite knowledge about them. Mr. Hopkins was lately prevented by the Indians from ascending the Chepo river towards Mandinga, or San Blas bay;* and Dr. Cullen was stopped likewise by the aborigines while endeavouring to ascend the Paya

* Mr. Wheelwright was stopped also there, in 1837.

river, that runs from near the mouths of the Atrato to the Tuyra, which falls into the gulf of San Miguel.

The narrowness of the isthmus between Mandinga, or San Blas bay, and Chepo, and the refusal of the aboriginal Indians to allow of its examination, are incentives to explore the locality. From sea to sea there are about 27 miles. San Blas bay has ample harbourage; and the natives *drag canoes across* from the Concepcion, or Mandinga river, to the Chepo, which rises near the north coast. But there is no port at the mouth of the Chepo; on the contrary, a long extent of flat shoal is uncovered at low water, which prevents the approach of ships nearer than *four miles*.

Farther eastward are the tracks from Caledonia bay to the gulf of San Miguel; one of which Wafer travelled in 1681, with other buccaneers, to attack the Spanish mining villages of Santa Maria and Cana. The river then called Santa Maria is the same as the Chuquanaqua (if not the Savana), which rises about eight miles from Scotch harbour (Port 'Escoces'), in Caledonia bay. There is a range of hills between them, which the buccaneers (who, intending to *surprise* the Spaniards, did not take the *usual* track) found difficult to cross. There is also good reason to suppose that the Indians did not willingly show the best paths to their rather dangerous allies.

Any route that could be made available between San Miguel gulf and Caledonia bay, or the gulf of Darien or Choco, would have the advantage of excellent harbours at each end, and a great rise of tide in one of them (San Miguel). The river Savana is recommended by Dr. Cullen, from personal examination, as being more navigable (for canoes), and approaching nearer the north coast than the Chuquanaqua does; though this does not appear in the Spanish maps.* From the head of the Savana, a ravine, about three leagues in length, extends to Caledonia Bay, and there (Dr. Cullen says, having passed through it), *he* thinks, a canal might be cut with less difficulty than elsewhere, if it were not for the opposition of the natives. He also speaks of the Indians transporting their canoes across at this ravine; and of the comparative healthiness of this part of the isthmus.

Doubtless, the unhappy Scotch colony (of 1695-1700), so well planned, but so cruelly betrayed and ill-treated, had good reasons for selecting that part of the isthmus for their settlement, having obtained the fullest information from Wafer and other buccaneers.

* The Savana rises near Caledonia bay, and runs into the Tuyra, to the westward of the Chuquanaqua. Access from the sea, in San Miguel gulf, to the immediate vicinity of Port Escoces (Scotch bay), is said to be easier by this river than by the Chuquanaqua. Dr. Cullen traversed this space very recently, and states that a valley leads from Caledonia bay to the Savana, in which valley the lowest summit level does not exceed 400 feet (by his estimation) above the sea.

The locality was so much liked by the Scotch adventurers that, even after their utter ruin and dispersion, the leaders (in particular Paterson) wished and endeavoured to organise another expedition *to the same place*. In those days much gold was obtained near San Miguel gulf. The climate of the higher grounds was pleasant; and the soil was remarkably fertile. General commerce with the Indies and Europe, slave trade with the Spanish colonies, and obtaining gold from the neighbouring mines, were no doubt chief inducements to the Scotch colonists; *besides opening a way through the Isthmus, which there is so narrow*. One of the adventurers in the Scotch enterprise speaks of the harbour of New Edinburgh (as it was then called) and the adjacent district in the highest terms of praise, saying, among other things, "We have already had Dutch, French, and English, all at the same time in our harbour; and all of them wondering what the rest of the world have been thinking about while we came here to the best harbour in the best part of America.* The soil is rich, the air temperate, the water sweet."

Very rich mines were then worked in that vicinity; but, so harassed were the Spaniards by repeated incursions of the buccaneers, by the Indians, and by the alarming attempt of the Scotch to colonise so close to the real 'El-dorado,' that early in the last century the mines of Cana and others in the neighbourhood were concealed and abandoned. The miners and their strong guards of soldiers were withdrawn, and all the forts dismantled. No traces of Cana are visible. Santa Maria is likewise overgrown and hidden. Only a few straggling gold-washers now visit that neighbourhood occasionally.

Between the bottom of the gulf of Darien (or Choco) and San Miguel there may be means of effecting a good passage by land as well as by water; but this tempting situation—low, narrow, nearly intersected by rivers, and lying between excellent harbours—has not lately been explored. The rivers Paya, Cucarica, and Atrato are here in close proximity; and near, likewise, to the situation of the most famous mines, those of Cana. The Tuyra runs into the gulf of San Miguel; the Paya into the Tuyra; and the Cucarica, besides other small rivers, into the Atrato. Near the sources of the Tuyra were the very rich mines of Espiritu Santo, said to be the richest gold mines then worked in America.

Probably, the climate in these low woody regions is very deleterious; however innoxious it may be on the heights or on the open sea-shore. Indeed there must be some permanent local difficulties of a serious character, that have assisted the Spaniards

* History of Caledonia, or the Scots Colony in Darien. London: 1699.

and the Indians in keeping curious travellers out of such rich districts, otherwise they would have been peopled (and ransacked like California) ages ago. On all accounts, however, this is an extremely interesting quarter, highly deserving of exploration.

With a few general observations this paper shall be concluded.

Of all the comparatively well-known routes, it has been shown that the Atrato and Cupica line seems the most suitable for a *canal*, and the Panama route for a *railway* or *road*; and that, of other less explored tracks, the most promising are those between the gulf of Darien and San Miguel.

Captain Moorsom acquaints us that the great Humboldt (after half a century of active interest in this subject, and after accumulating and digesting infinitely more information about Central America than any other person), "is thoroughly satisfied that the Isthmus of Darien is superior to any other portion of the entire neck for a canal." And to an opinion, *nearly* similar, it may be presumed that unprejudiced persons will now generally come; but until surveys are effected, and indispensable details of information obtained, it will not be possible to arrive at any *certain* conclusion.

Climate and natives * are at present the only serious impediments to a regular survey, or examination with measurement. Is it not then advisable to make terms with those natives without delay; to choose the proper season for exploring; and to refrain from compromising capital as well as character by supporting any undertakings not based on sufficient information, and that do not, even in the outset, afford any reasonable hopes of a result in any manner remunerating? Exact descriptions and very careful measurements are indispensable before any great work can be judiciously begun, but they have not yet been executed throughout the whole extent of any line, except one.

Whatever may be the physical obstacles to either a canal or a

* A reply was lately made to the British consul at Panama, by a young Darien Indian, who had lived in his house for some time, that if the consul (Mr. Perry) attempted to pass through his country, he would be "the first to drive a poisoned arrow" into him.—(*Liot*, pp. 37, 38.) The determined opposition made by natives of the same neighbourhood, if not of the same tribe, to the attempt of Mr. Hopkins to ascend the Chepo, and Dr. Cullen the Paya river—the precautions adopted in navigating the Atrato—(*Cochrane*, vol. ii. p. 455)—besides many similar instances, show that an intricate question is to be solved in that quarter, before even a survey can be made. In Choco there are other Indian aborigines, usually at war with those of Darien, and with the descendants of the Spaniards.^a

^a March 18, 1824.—Passing down the river (Atrato) we saw the high land inhabited by the Cuna Indians, of whom the boatmen were formerly much afraid, as they frequently waylaid them, and, putting all the crew to death, by a flight of arrows, captured the vessels, and carried off the booty.—*Cochrane*, vol. ii. p. 453.

railroad between any places in Central America, it appears to be indisputable that the insalubrity of the climate, and the excessive quantity, as well as frequency and duration of rain, are the impediments most permanently formidable.

Whether we look at Humboldt's accounts of the inundations in Mexico, or reflect on the scanty and dispersed population of districts so rich and fertile as those of Choco and Darien, the mind is struck by the excessive difficulties which such a climate superadds to any work of man.

It is not that the transit of passengers, or even of ships, will be materially affected by these causes, when once an easy, and therefore rapid means of transit is secured ; but it is the health of those who must be *permanently* employed there, throughout the whole year, that is so weighty a consideration.

In Central America there are two seasons, one of which, though called winter, is when the sun is nearly vertical : and the opposite period, when the sun is not so high at noon, is the summer ; in which hot and dry weather prevails, accompanied by a clear and healthy air. In the northern parts of the Isthmus the dry season lasts longer than about Darien and Choco, where there are only short intervals without some rain. About three months in the year can alone be depended on, as dry and truly fine weather, in the vicinity of the Gulf of Darien. At that time regular breezes prevail from the northward and eastward, interrupted though occasionally by gales from the north. In the season called winter the sun is seldom seen, so clouded is the sky, and so frequent are the torrents of rain. The air is then extremely sultry. Lightning and thunder are very frequent, and westerly winds, with hard squalls, are prevalent. There is a short interval of fine weather in the middle of the rainy season, near the end of June (called the little summer of St. John), but the regular and continued summer, a very dry and parching time in the northern parts of the Isthmus, lasts from December to April or May, in which period *only* could extensive operations be carried on advantageously.

With respect to salubrity, there is no doubt (as has been previously mentioned) that in low places, near rivers especially, where fresh and salt waters mix, where mangrove trees abound, and decomposition is rapid, the climate is very unhealthy—often fatally so ; contagious miasmata of sulphuretted hydrogen and carbonic acid gas being abundant. But in higher regions, where the ground is less hidden from the sun and wind, and noxious vapours are not generated, there is nothing in the climate to injure a healthy European, who lives temperately and avoids extremes.

Among all the travellers, seamen, and other adventurers, who have been for some time much exposed in those places, very few

lost their lives there, though many have had ague or fever—some the dangerous yellow fever, or other maladies. Nevertheless, unseasoned white men cannot, generally speaking, work hard in that climate, exposed to sun or rain, like men of colour. They cannot labour in the muddy banks of the tropical rivers, in cane or mangrove swamps, or on exposed and scorching rocks. Their health would inevitably give way, however vigorously a few hardier constitutions might persevere for a time. This consideration militates against the employment of European convicts, and should induce the engagement of acclimatised persons (if not of colour) to superintend, as well as to execute, undertakings of magnitude.

Ordinary labourers must be sought among the darker varieties of the human race. They may be obtained from several places in the West Indies, from the United States, from the Kroo coast of Africa, and Liberia; from the Philippine Islands, China, Polynesia, the East Indies, and various parts of America. Of all these, the Kroo men and the Chinese would probably be the most industrious and manageable. On the correct treatment of labourers and their equitable and prompt payment, very much would depend; but this branch of the subject demands separate consideration. Next to the supply and management of adequate funds, it is the most important auxiliary.

In this summary review an impartial examination of advantages, as well as obstacles, has been freely attempted. In conclusion, it may be observed that no memorial of the power of human skill and exertion—not the Mexican ‘Desagüe,’ nor the wall of China, nor the pyramids of Egypt, would be more remarkable: while in practical and general utility to the whole world no other physical undertaking would bear comparison with such an achievement as a ship-canal.

The immense increase of easy, rapid, and popular communications between regions no longer remote—the wide diffusion of knowledge; and the spread of Christian civilization—would undoubtedly be the inestimable consequences of forcing the barrier of Central America.

Of results so amply and so eloquently foretold by authors of established reputation, it would here be superfluous and presuming to say more than to express a patriotic hope that Great Britain will achieve them—and will then throw open the grand work for the permanent benefit of the world.

LIST OF AUTHORITIES.—Admiralty (Hydrographic Office); Alcedo; Baily; Burney; Byam; Chevalier; Cochrane; Coutin; Cullen; Dampier; Davis; Edwards; Falmarc; Galindo;

Galisteo ; Garay ; Garella ; Guzman ; Hamilton ; Hopkins ; Hughes ; Jefferys ; Juan ; Lawrence ; Liot ; Lloyd ; M'Queen ; Mollien ; Morel ; Louis Napoleon ; O'Leary ; Pitman ; Purdy ; Scarlett ; Stephens ; Squier ; Ulloa ; Wafer ; Watts ; Wheelwright ; Wood :—besides the standard works of Humboldt ; and old as well as modern charts and maps.

Note upon the Language of Central America.

By R. G. LATHAM, M.D.

IN Yucatan the structure and details of the language are sufficiently known, and so are the ethnological affinities of the tribe who speak it. This language is the *Maya* tongue, and its immediate relations are with the dialects of Guatemala. It is also allied to the Huasteca spoken so far N. as the Texian frontier, and separated from the other *Maya* tongues by dialects of the Totonaca and Mexican. This remarkable relationship was known to the writers of the *Mithridates*.

In South America the language begins to be known when we reach the equator ; *e.g.* at Quito the Inca language of the Peruvian begins, and extends as far south as the frontier of Chili.

So much for the extreme points ; between which the whole intermediate space is very nearly a *terra incognita*.

In Honduras, according to Colonel Galindo, the Indians are extinct ; and, as no specimen of their language has been preserved from the time of their existence as a people, that state is a blank in philology.

So also are San Salvador, Nicaragua, and Costa Rica ; in all of which there are native Indians, but native Indians who speak Spanish. Whether this implies the absolute extinction of the native tongue is uncertain : it is only certain that no specimens of it are known.

The Indian of the Mosquito coast is known ; and that through both vocabularies and grammars. It is a remarkably unaffiliated language—more so than any one that I have ever compared. Still, it has a few miscellaneous affinities ; just enough to save it from absolute isolation. When we remember that the dialects with which it was conterminous are lost, this is not remarkable. Probably it represents a large class, *i.e.* that which comprised the languages of Central America *not* allied to the *Maya*, and the languages of New Grenada.

Between the Mosquito country and Quito there are only two vocabularies in the *Mithridates*, neither of which extends far beyond the numerals. One is that of the dialects of Veragua called *Darien*, and collected by Wafer ; the other the numerals of the famous Muysca language, of the plateau of Santa Fé de Bogota. With these exceptions, the whole philology of New Grenada is unknown, although the old missionaries counted the mutually unintelligible tongues by the dozen or score. More than one modern author—the present writer amongst others—has gone so far as to state that all the Indian languages of New Grenada are extinct.

Such is not the case. The following vocabulary, which in any other part of the world would be a scanty one, is for the parts in question of more than average value. It is one with which I have been kindly favoured by Dr. Cullen, and which represents the language of the Cholo Indians inhabiting part of the Isthmus of Darien, east of the river Chuquanaqua, which is watered by the river Paya and its branches in and about lat. 8° 15' N., and long. 77° 20' W. :—